

CLAIMS

1. **Lawn mowing apparatus comprising:**
 - (a) **drive means for moving said apparatus, said drive means including operator control means for placing said drive means in a forward, reverse, or neutral mode of operation;**
 - (b) **a cutting blade;**
 - (c) **power-take-off drive means connecting said drive means (a) to said cutting blade (b) for imparting rotatable movement to said cutting blade to cut grass and other vegetation;**
 - (d) **cut-off means connected to said operator control means and said power-take-off drive means, said cut-off means disconnecting said cutting blade from said power-take-off drive means when said operator control means is in reverse mode of operation and for automatically connecting said cutting blade to said power-take-off drive means when said operator control means is subsequently placed in said forward or neutral mode of operation.**
2. **Apparatus as recited in claim 1 wherein said power-take-off drive means comprises an electric clutch for selectively engaging and disengaging said cutting blade.**
3. **Apparatus as recited in claim 2 wherein said cut-off means comprises an electrical switch means for selectively (i) providing electrical power to said electric clutch to engage said cutting blade and (ii) preventing the flow of electric power to said electric clutch to disengage said cutting blade.**
4. **Apparatus as recited in claim 3 further comprising a mechanical linkage connecting said operator control means to said electric switch means.**
5. **Apparatus as recited in claim 4 wherein said mechanical linkage comprises a first and second control lever pivotally mounted to said apparatus, said electrical switch means comprising a first and second switch electrically**

connected to each other in parallel in an electrical circuit connected to said electric clutch, said first and second switches being normally closed to allow flow of electric power through said electric circuit to said electric clutch, said first and second levers each carrying first and second roller members respectively adapted for selective engagement and non-engagement with said first and second switches, wherein both said first and second switches are contacted by said rollers when both of said levers are positioned in the reverse mode of operation and electrical power to said electric clutch is thereby prevented.

6. Apparatus as recited in claim 5 wherein said drive means comprise first and second drive wheels operatively connected to said first and second control levers respectively, said first control lever adapted for placing said first drive wheel in said forward, reverse, or neutral mode of operation, and said second control lever adapted to place said second drive wheel in said forward, reverse, or neutral mode of operation, said first and second electrical switches being normally closed, thereby allowing electric flow to said electric clutch, said first and second rollers contacting said first and second switches when both said first and second levers are placed in a reverse mode of operation to thereby prevent flow of electricity to said electric clutch.

7. Apparatus as recited in claim 6, wherein said mechanical linkage further comprises first and second leaf springs, said first leaf spring being interposed between said first roller and said first switch, said second leaf spring being interposed between said second roller and said second switch.

8. A mowing machine comprising:

a frame;

an engine;

a cutting blade rotatably mounted to the frame via an electric blade clutch;

a controllable accessory power take off drive (PTO) electrically coupled with the electric blade clutch;

a PTO switch associated with the PTO and the electric blade clutch, the PTO switch having "ON" and "OFF" positions such that the PTO may energize the electric blade clutch when the PTO is in the "ON" position and electrical connection between the PTO and electric blade clutch exists;

a pair of cut-out switches electrically connected to the PTO and the electric blade clutch;

a transmission system governing the speed and rotational direction of corresponding right and left drive wheels;

a pair of transmission control levers operatively associated with the transmission system, each of the control levers being selectively movable into one of a forward, neutral or reverse gear position corresponding to a desired speed and direction of travel of the right or left drive wheels;

each of the cut-out switches being mounted to the mowing machine for selective contact or non-contact by a corresponding one of the control levers whereby the cut-out switches electrically connect the PTO with the electric blade clutch and engage the cutting blades when either or both of the cut-out switches are in a first position and the PTO switch is "ON" and disconnect the PTO from the electric blade clutch and disengage the cutting blades when both of the cut-out switches are in a second position, and contact or non-contact positioning of the control levers with the switches determines whether the cut-out switches are in the first position or the second position, whereby the cutting blades may be automatically engaged by placing one of said cut-out switches in the first position after both of said switches have been in said second position.

9. The mowing machine of claim 8, wherein each cut-out switch further comprises:

a mounting bracket;
an electrical coupler;
a leaf spring; and
a plunger,

wherein each electrical coupler connects one of the cut-out switches with the PTO and the blade clutch, and each mounting bracket mounts one of the cut-out switches to the mowing machine, each cut-out switch being mounted such that biasing contact of each of the leaf springs by a corresponding one of the control levers depresses the plungers, thereby placing the cut-out switches into the second position, and non-biasing contact of each of the leaf springs by the corresponding control levers extends the plungers, thereby returning the cut-out switches to the first position.

10. The mowing machine of claim 9, wherein depression of a plunger occurs when a corresponding one of the control levers is placed into the reverse gear position.

11. The mowing machine of claim 9, wherein extension of a plunger occurs when a corresponding one of the control levers is placed into one of the neutral or forward gear positions.

12. The mowing machine of claim 9, wherein depression of a plunger occurs when a corresponding one of the control levers is placed into either of the neutral or reverse gear positions.

13. The mowing machine of claim 12, wherein positioning of either of the control levers in the forward gear position causes a corresponding cut-out switch plunger to extend, thereby placing the corresponding cut-out switch in its first position, re-connecting the PTO and the electric blade clutch, and re-engaging the cutting blades.

14. The mowing machine of claim 9, wherein each cut-out switch is arranged in parallel relative to one another and in series between the electric blade clutch and the PTO.

15. The mowing machine of claim 9, wherein a bottom portion of each control lever contacts a corresponding one of the leaf springs.

16. The mowing machine of claim 15, the bottom portion of each control lever further comprises:

- a plate;
- a sleeved bracket;
- a pivot weldment;
- a pivot shaft;
- a set of linkages,

wherein one side of each plate is mounted to the mowing machine and another side of each plate is mounted to the sleeved bracket, each pivot weldment is received in one of the sleeved brackets and is connected to one of the pivot shafts, each pivot shaft is connected to one set of linkages, each set of linkages being associated with a corresponding right drive transaxle or left drive transaxle, whereby one set of linkages determines the speed and rotational direction of a right drive wheel and the other set of linkages determines the speed and rotational direction of a left drive wheel according to the gear positions of each control lever.

17. A method of automatically disengaging and re-engaging cutting blades of a mowing machine, the method comprising:

providing a mowing machine having an engine, a transmission, at least one transmission control lever, a controllable accessory power take off drive (PTO) coupled to an electric blade clutch, a PTO switch having an "ON" and "OFF" position, a cutting blade engagable by the electric blade clutch, and at least one cut-out switch between the electric blade clutch and the PTO, each

cut-out switch having a first position that connects the PTO with the electric blade clutch when the PTO switch is "ON" and at least one cut-out switch is in the first position, and a second position that disconnects the PTO from the electric blade clutch when all cut-out switches are in the second position;

starting the engine;

turning the PTO switch to an "ON" position;

shifting at least one of the transmission control levers into a non reverse gear position to place at least one cut-out switch into the first position thereby connecting the PTO with the electric blade clutch and engaging the cutting blades;

shifting all of the transmission control levers into the reverse gear position to place all of the cut-out switches into the second position thereby disconnecting the PTO switch from the electric blade clutch and disengaging the cutting blades; and

shifting at least one of the transmission control levers into one of the non-reverse gear positions to place at least one of the cut-out switches into the first position thereby re-connecting the PTO with the electric blade clutch and re-engaging the cutting blades.

18. The method of claim 17, wherein the mowing machine is a two-control lever ZTR mowing machine and the cut-out switches are in parallel relative to one another and in series between the PTO switch and the electric blade clutch.

19. An electric control circuit for a lawn mowing machine, said circuit comprising:

a magneto-operated engine with a power source;

a key switch having first, second, and third positions;

a first circuit for connecting said magneto to ground when said key switch is in said first position, thereby preventing said engine from running;

a second circuit for connecting a battery to a starter when said key switch is in said third position, thereby causing said engine to start;

a third circuit for connecting said battery to a regulator terminal when said key switch is in said second position, thereby causing said engine to run; and

a fourth circuit for connecting said power source to an electric blade clutch, said fourth circuit including a PTO switch and at least one cut-out switch, thereby energizing said electric blade clutch so long as said engine is running, said PTO switch is closed, and at least one of said cut-out switches is closed.

20. The electric control circuit of claim 19, further comprising:

an operator presence detector switch for connecting said magneto to ground when an operator is not present so as to prevent said engine from running;

a brake switch having an off position, a first closed position, and a second closed position;

wherein said second circuit is interrupted when said brake switch is in said off position, thereby preventing said engine from starting;

wherein said second circuit is not interrupted when said brake switch is in said first closed position, thereby allowing said engine to start; and

wherein connection is made between said magneto and ground when said brake switch is in said second closed position, thereby preventing said engine from running.

21. The electric control circuit of claim 19, wherein said key switch automatically moves to said second position when said key switch is released from said third position.

22. The electric control circuit of claim 20, wherein said key switch automatically moves to said second position when said key switch is released from said third position.

23. A system for activating and deactivating a power-take-off (PTO) drive of a lawn mowing machine, said system comprising:

a magneto operated engine with a power source;

an electric clutch associated with said PTO drive;

a pair of cut-out switches electrically connected to said electric clutch, said switches having a first position and a second position;

a pair of transmission levers, said transmission levers having a forward position, a neutral position, and a reverse position;

wherein one of said transmission levers is operatively associated with one of said cut-out switches, and the other one of said transmission levers is operatively associated with the other one of said cut-out switches, linkage means connecting said levers and said switches so that when said one of said transmission levers is shifted into said forward position or said neutral position, said one of said cut-out switches is placed into said first position, and when said one of said transmission levers is shifted into said reverse position, said one of said cut-out switches is placed into said second position, and when said other one of said transmission levers is shifted into said forward position or said neutral position, said other one of said cut-out switches is placed into said first position, and when said other one of said transmission switches is shifted into said reverse position, said other one of said cut-out switches is placed into said second position;

wherein if either one of said cut-out switches is placed into said first position, said electric clutch will be energized by said power source, thereby activating said PTO drive; and

wherein if both of said cut-out switches are placed into said second position, said electric clutch will not be energized by said power source, thereby deactivating said PTO drive.